Reminders

- **Readings this week**
  - Goldstein Chapters 6 & 7
- **Quiz 5 DUE this Friday**
- **Questions about your Exam?**
  - come to office hour to look over

Long Term Memory:

Encoding

Life without long-term memory

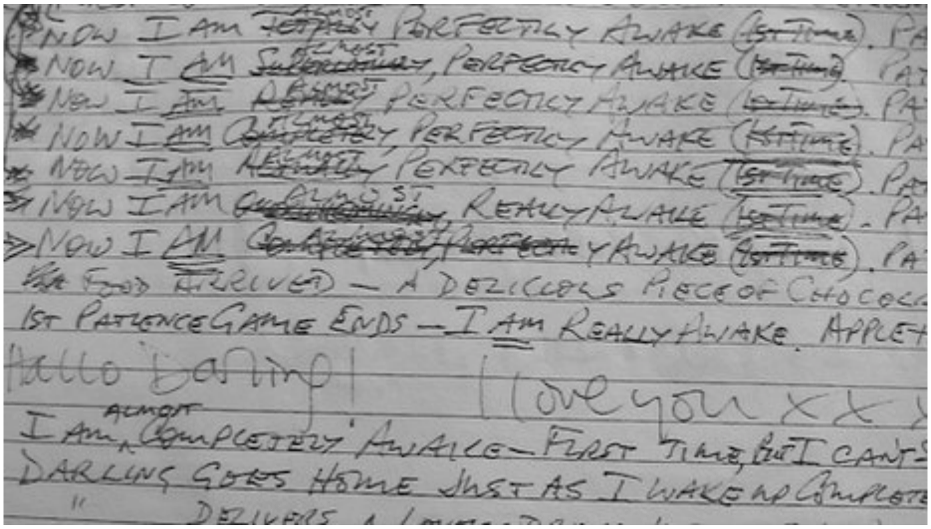
Clive (from Baddeley, 1990)

“His amnesia was so dense that he could remember nothing from more than a few minutes before, a state that he attributed to having just recovered consciousness. Left to his own devices, he would often be found writing down a time, for example 3:10, and the note “I have just recovered consciousness” only to cross out the 3:10 and add 3:15 and then 3:20, etc. If his wife left the room for a few minutes, when she returned he would greet her with great joy, declaring that he had not seen her for months and asking how long he had been unconscious. . . “

V

Clive Wearing’s diary

http://www.youtube.com/watch?v=Vwigmktix2Y

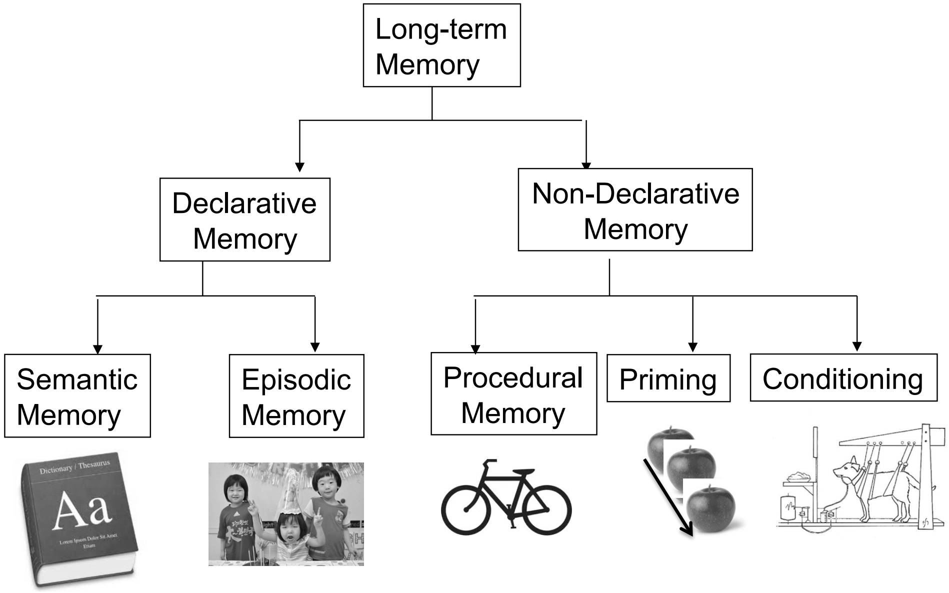


NOW I AM ~~[illegible]~~ ALMOST PERFECTLY AWAKE (~~1st Time~~). PA
NOW I AM ~~SUPERLATIVELY~~ ALMOST, PERFECTLY AWAKE (~~1st Time~~). PA
NOW I AM ~~ACTUALLY~~ ALMOST PERFECTLY AWAKE (~~1st Time~~). PA
NOW I AM ~~COMPLETELY~~ ALMOST, PERFECTLY AWAKE (~~1st Time~~). PA
NOW I AM ~~ACTUALLY~~ ALMOST PERFECTLY AWAKE (~~1st Time~~). PA
NOW I AM ~~[illegible]~~ ALMOST, REALLY AWAKE (~~1st Time~~). PA
NOW I AM ~~COMPLETELY~~ ALMOST, ~~PERFECTL~~Y AWAKE (~~1st Time~~). PA
FOOD ARRIVED — A DELICIOUS PIECE OF CHOCOL
1ST PATIENCE GAME ENDS — I AM REALLY AWAKE. APPLE
Hello Darling! I love you x x
I AM ALMOST COMPLETELY AWAKE — FIRST TIME, BUT I CANT
DARLING GOES HOME JUST AS I WAKE UP COMPLETE
" DELIVERS A [illegible]

Types of Long-term Memory

- **Declarative**
  - Semantic
  - Episodic (Autobiographical)
- **Non-Declarative**
  - Procedural
  - Implicit learning (priming)
  - Conditioning

Types of Long-term Memory



Long-term Memory

Declarative Memory

Non-Declarative Memory

Semantic Memory

Episodic Memory

Procedural Memory

Priming

Conditioning

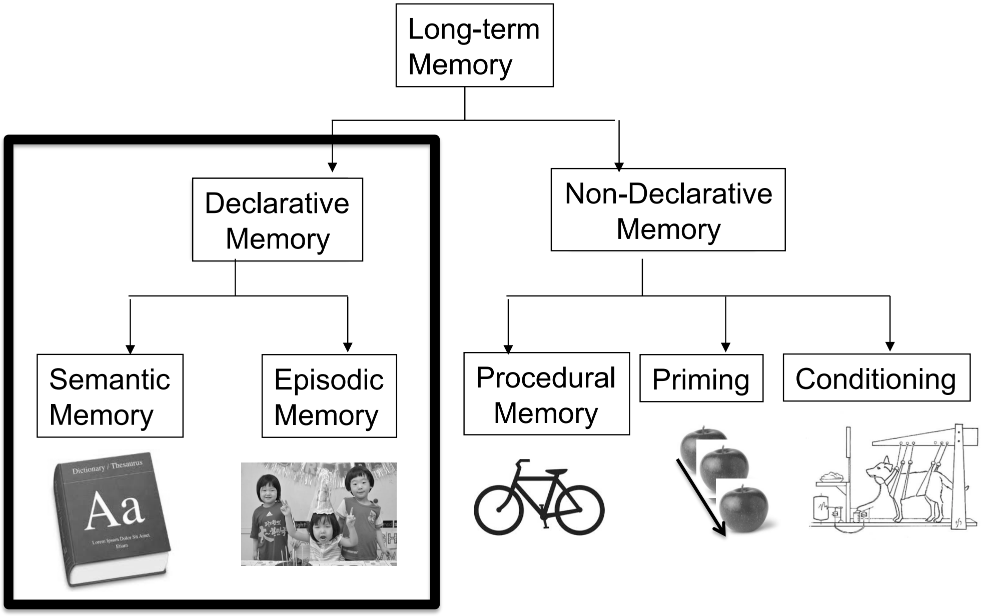
Declarative Memory

- **Flexible, relational, used in various ways; talked about**
- **Semantic**
  - ☐ knowing that…
  - ☐ no time-stamp
  - ☐ source unknown; you just "know" it
  - ☐ examples: mom's birth date, when you put gas in the car, how to spell *declarative*
- **Episodic (Autobiographical)**
  - ☐ specific episodes in time
  - ☐ time-stamped
  - ☐ known source
  - ☐ examples: your 5th birthday party, graduation party

Non-declarative Memory

- **Difficult to express in language; used in specific ways**
- **Procedural**
  - ☐ knowing how…
  - ☐ examples: how to ride a bicycle, how to type, how to use your language
- **Priming**
  - ☐ implicit learning
  - ☐ experiencing stimulus multiple times changes response
  - ☐ examples: word read faster second time
- **Conditioning**
  - ☐ classical and operant
  - ☐ examples: associate lights with shock; slot machines

Types of Long-term Memory



- Long-term Memory
  - Declarative Memory
    - Semantic Memory
    - Episodic Memory
  - Non-Declarative Memory
    - Procedural Memory
    - Priming
    - Conditioning

Capacity and duration

- What is the capacity of long-term memory?
  - perhaps UNLIMITED
- What is the duration of long-term memory?
  - some last a lifetime
  - sometimes even with no practice
    - e.g., college foreign language
    - recall declines over first 3-6 years
    - then stable for at least 30-35 years

➢ Critical problem is FINDING information!

LTM: Methods

- **Basic methodological terms**:
- **Encoding**: learn the material.
    - ☐ incidental: without trying
    - ☐ intentional: when you try to learn
- **Retrieval**: access the material.
    - ☐ recall: you generate the material
        - cued vs. uncued
    - ☐ recognition: you identify studied (“old”) material
        - targets and lures

Strategies for encoding

- How can we store information in memory so that we can find it when we need it?

Repetition

- More likely to remember something if exposed to it more than once.
- BUT, better when repetitions are *spaced apart*, rather than massed together:
- Why?

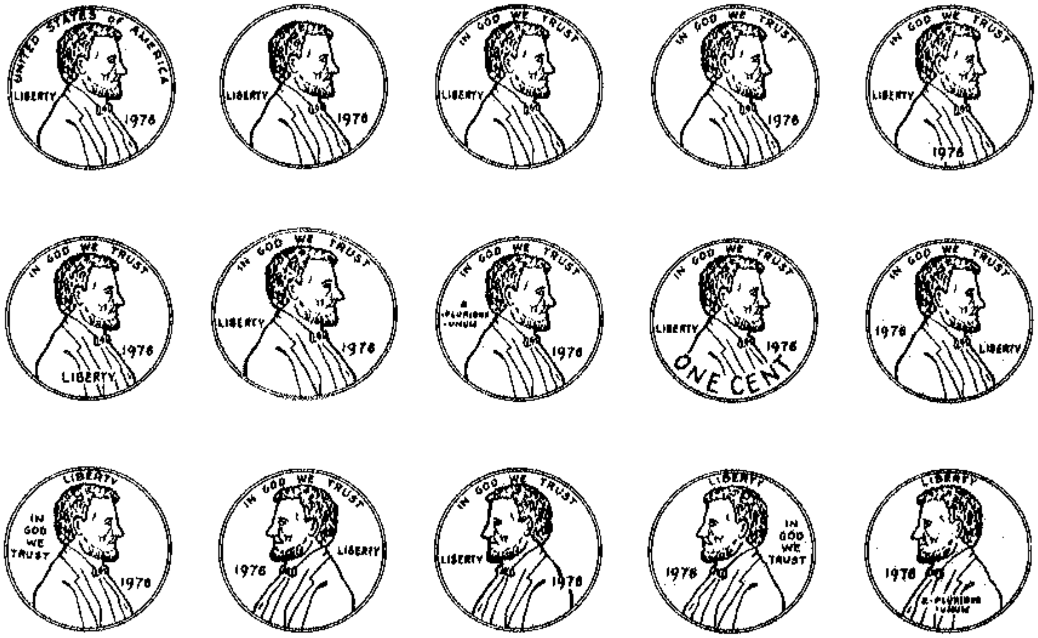
Practice

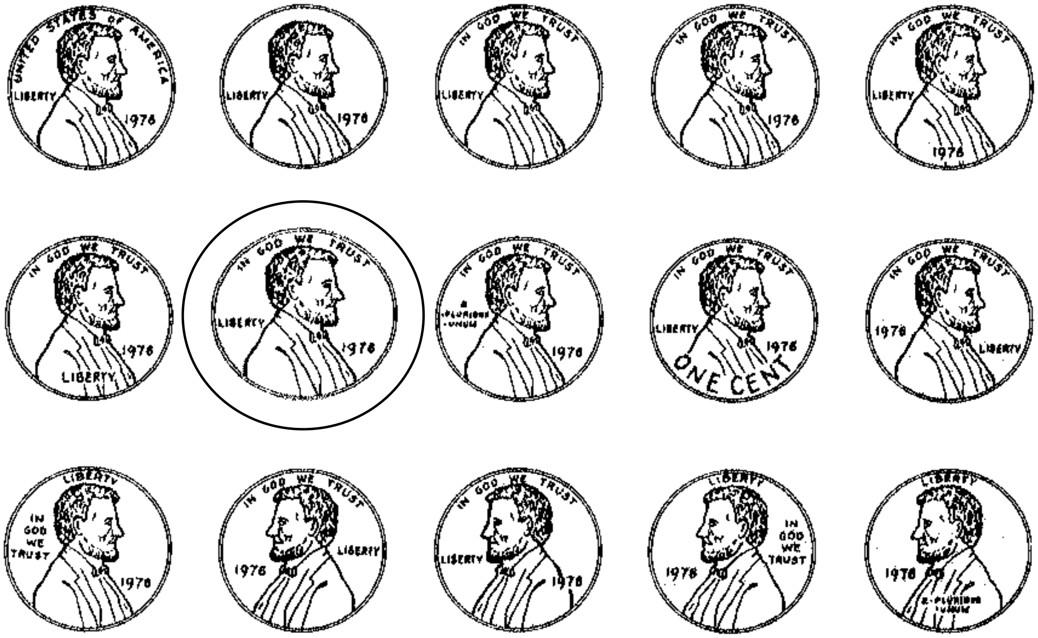
- Both amount & distribution of practice matter.
- Better to have less practice/day, distributed across more days.
- Better to have repetitions separated by other things.
- Best practice comes from retrieving the information at expanding intervals.

Is repetition enough?

- Will stimuli that have been seen often enough automatically become encoded in long-term memory?

- How many times have you seen a penny?
- Which of the following is the right penny:





No, repetition is NOT enough!

- Need more than simple exposure.
- Even many repetitions may not be enough to ensure that something will be encoded.

Organization

- People naturally organize information
  - adults do, though children may not

- Experiment by Tulving
  - Gave people a list of words:
    magazine, clock, executive, airplane
  - Asked to recall (and describe strategy)
  - People who organized the most remembered the best

Different ways of organizing

- Taxonomic (have similar properties)
  - e.g., birds, fruits, furniture
- Thematic (making up a story)
  - e.g., dog, bone, hole
  - Works especially well for things that must be remembered in order.

Mnemonics

- first-letter mnemonic
  - use first letter of words in phrase as cue
- peg-word systems
  - organized structure allows you to “hook” to-be-learned information on the “pegs”
- method of loci
  - things to be remembered placed at locations in familiar space

Mnemonics– Let’s try it!

List 1– remember by repeating

- **duck**
- **annex**
- **cactus**
- **transmit**
- **basket**
- **obstruct**

List 2– remember by peg-words

- one is a bun -- **picnic**
- two is a shoe – **snap**
- three is a tree – **compress**
- four is a door – **enrich**
- five is a hive – **distinct**
- six are sticks -- **bud**

Why does organization help?

- One type of elaborative encoding.
- Linking new information to prior knowledge.
- Provides “support” for new information (and cues for how to find it).

- LEVELS (DEPTH) OF PROCESSING
  - Shallow: surface, perceptual features
  - Deep: linked to meaning

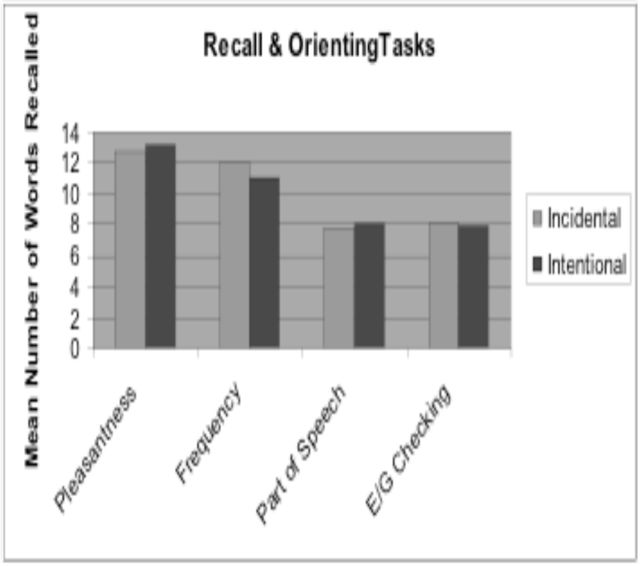
Depth of processing example

(Hyde and Jenkins)

CANOE

- Does the word have an ‘e’?
- Is it a noun?
- How often do you think you see this word?
- How pleasant do you find this word?

Results

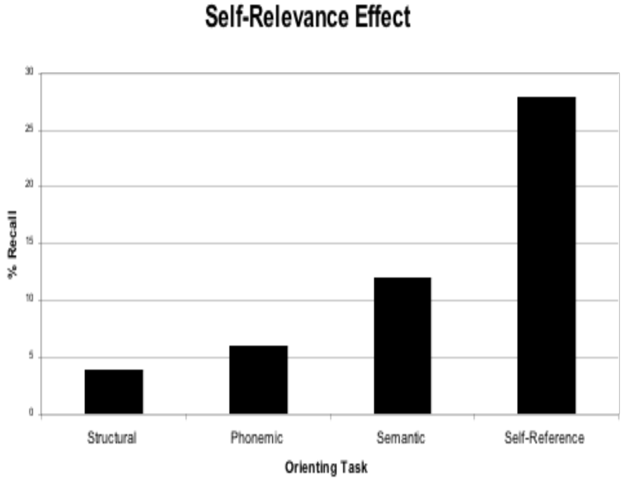


- Better recall for deeper (meaning-based) encoding.
- Performance *unaffected* by whether or not subjects knew that there would be a memory test!

Elaboration through self-reference

- Study list of words by:
  - Appearance (structural)
    - Are there any capital letters in it?
  - Sound (phonemic)
    - Rhymes with . . . ?
  - Meaning (semantic)
    - Means the same as . . . ?
  - Self-Relevance
    - Does this adjective describe you?

Results



- Judgments about self lead to better recall than other common tasks.
- Particularly good type of elaboration because we know a lot about ourselves.
- Advertisers use this.

Generation Effects (Slamecka and Graf)

Read

Remember:

cold
white
dry
old

Generate

Antonym:

hot: c___
black: w___
wet: d___
young: o___

Generation Effects (Slamecka and Graf)

- Read
- Generate
  - Opposite
  - Associate
  - Same-Category
  - Synonym
  - Rhyme

- Generate condition led to better recall and recognition.
  - Roughly equal for all five generation conditions.
- Active learning better than passive learning.

Summary: Depth of Processing

- Doesn’t seem to matter if you are *trying* to learn or not -- only matters what you do.
- Encoding is better for:
  - organized information
  - meaning-based information
  - information with personal significance
  - information that was actively generated
  - elaborated information

Summary: Elaboration

- Elaboration involves . . .
  - making connections to knowledge
  - focusing attention on features from the current context

- Elaboration improves memory by . . .
  - imposing organization that can guide retrieval
  - increasing the number of contextual elements that can be retrieval cues

---

Write down all the words you can remember…

List 1– remember by repeating

- **xxx**
- **xxx**
- **xxx**
- **xxx**
- **xxx**
- **xxx**

List 2– remember by peg-words

- one is a bun -- **xxx**
- two is a shoe – **xxx**
- three is a tree – **xxx**
- four is a door – **xxx**
- five is a hive – **xxx**
- six is are sticks -- **xxx**

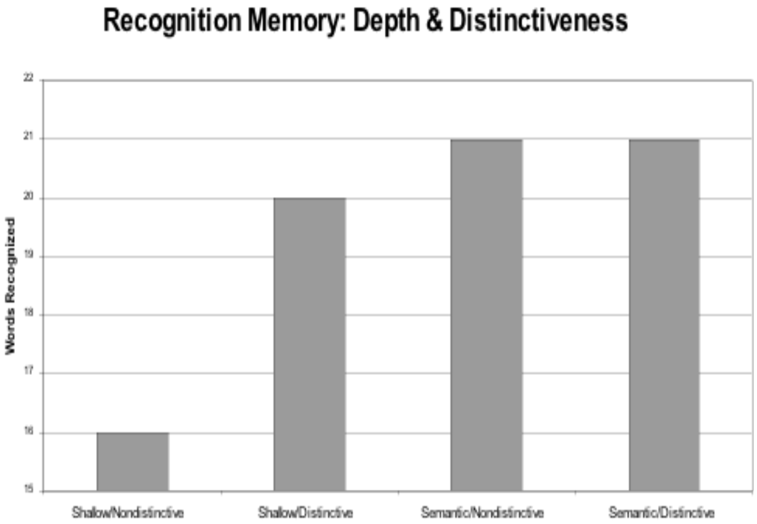
How many did you remember?

List 1– remember by repeating	List 2– remember by peg-words
■ **duck**	○ one is a bun -- **picnic**
■ **annex**	○ two is a shoe – **snap**
■ **cactus**	○ three is a tree – **compress**
■ **transmit**	○ four is a door – **enrich**
■ **basket**	○ five is a hive – **distinct**
■ **obstruct**	○ six is are sticks -- **bud**

Distinctiveness

- Eysenck & Eysenck: Is depth of processing all that matters? Or does task matter too?
- Study word lists – surprise test at end
  - ☐ **Shallow conditions**:
    - nondistinctive: say word normally (comb, glove)
    - distinctive: say using standard rules (comb; glove)
  - ☐ **Deep conditions**:
    - nondistinctive: say typical adjective (glove=> leather)
    - distinctive: say unusual adjective (glove=>wet)

Results



Recall was almost as high for the shallow as for the semantic task for distinctive words.

Task emphasized how they were different.

What’s Distinctiveness?

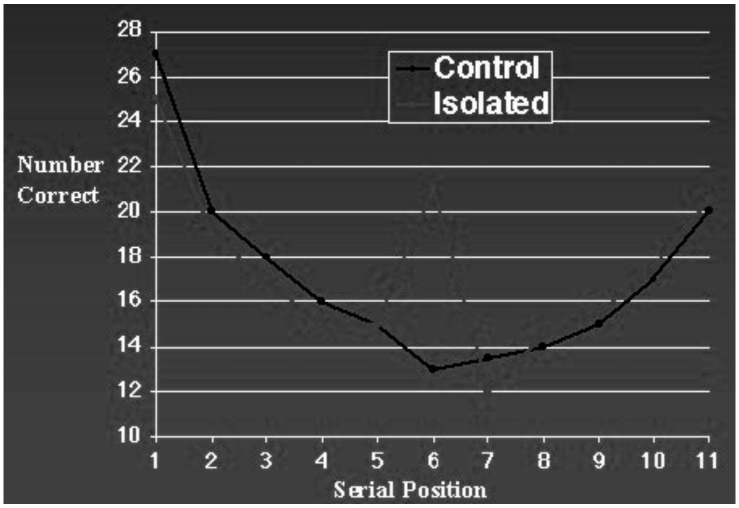
- Possessing features that makes it stand out from some contrast set
- Increases memory by
  - ☐ increasing attention at encoding
  - ☐ increasing retrievability
- Two major types of distinctiveness
  - ☐ Primary – with respect to the immediate context
    - Von Restorff effect
  - ☐ Secondary – with respect to prior experience
    - unusual faces, firsts, etc.

Primary Distinctiveness

- Incongruity defined with respect to immediate context
- Von Restorff Effect

- Apple
- Railway
- Magazine
- Leather
- Tower
- BOTTLE
- Pupil
- Sailor
- Diamond
- Library
- Ticket

Von Restorff Effect



Secondary Distinctiveness

- Incongruous with past experience
- Life experiences
  - First day at college
  - First time in a big city
- Orthographic distinctiveness
  - Words with unusual spellings well remembered
  - e.g., khaki, afghan
- Unusual faces
  - Unique faces easier to recognize than typical ones

Organization and Distinctiveness

- Organization involves encoding similarities
- Distinctiveness involves encoding differences
- Why do both help?

Resolution

- Different stimuli benefit from elaboration vs. distinctiveness
  - Related/common elements need distinctiveness
  - Unrelated/uncommon elements need elaboration

- Successful retrieval requires knowing where to look for information (elaboration helps) and being able to distinguish desired memory and similar ones (distinctiveness helps).

Encoding and Retrieval

- Not just encoding that matters.
- Need appropriate match between encoding and retrieval:
  - Transfer appropriate processing
  - Context-dependent learning
  - State-dependent learning

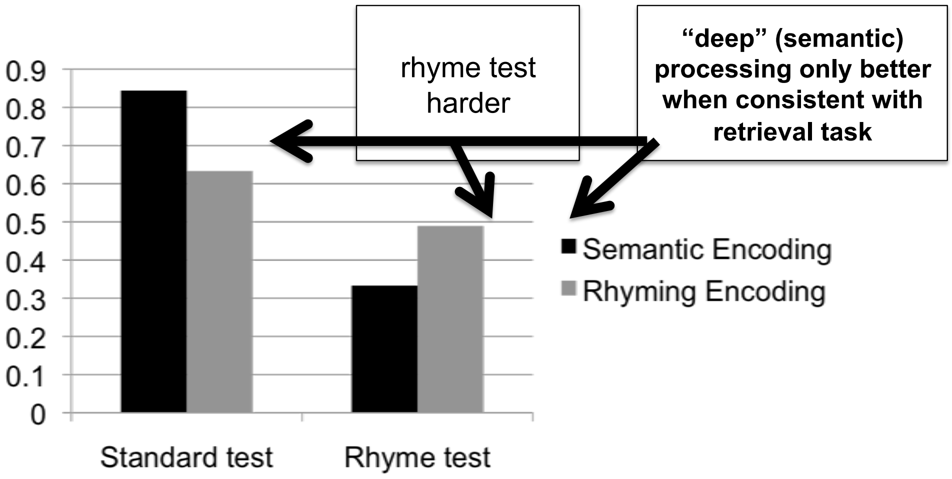
Transfer appropriate processing

- Question: Does memory depend only on depth of processing or does the match between encoding and retrieval matter?

Transfer appropriate processing

- **Encoding**: Learn a list of words:
  - ☐ rhyme task
  - ☐ meaning task
- **Retrieval**: *Recognize* the word.
  - ☐ rhyme cue
  - ☐ meaning cue
- **Depth of processing hypothesis**:
  - ☐ memory should be better for meaning task.
- **Transfer-appropriate processing hypothesis**:
  - ☐ memory better when encoding matches retrieval.

Results (Morris et al., 1977)



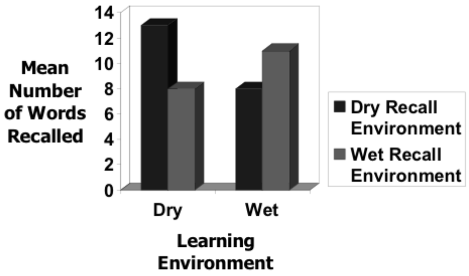
rhyme test harder

"deep" (semantic) processing only better when consistent with retrieval task

---

Context-dependent Learning

- Divers learned 40 unrelated words
  - On shore
  - 20 feet underwater
- Recall list in same or different environment.

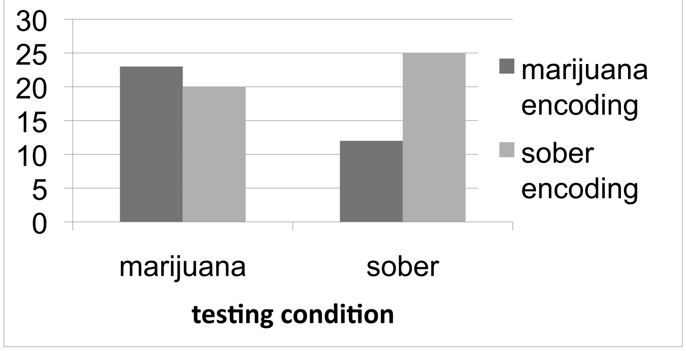


State-dependent Learning

- Recall easier when your mind/body is in the same state as during learning.
  - ☐ emotional state
  - ☐ physical state
  - ☐ chemical state

State Dependent Learning (Eich et al)

- Studied material while using marijuana (MJ) or not (C).
- Tested (4 hours later) while using marijuana or not.



Summary

- Want to have overlap of processes and environment between encoding and retrieval.
  - ☐ transfer-appropriate processing:
    do better if there is a match between how you encode information and how you retrieve it
  - ☐ context and state-dependent learning:
    do better if external and internal cues are similar at encoding and at retrieval

---

Thought question

John is given a few minutes to study this list of visual words:

banana, subway, newspaper, cotton, lighthouse, JAR, vacuum, eye, HOUSE, diamond, llama, museum, ticket

Which words is he most likely to recall an hour later? Why?